1. PLANT CONCEPT

TABLE OF CONTENTS

1.1 DEFINITIONS
1.2 INTRODUCTION
1.3 CONCEPT OF POWER SUPPLY
1.4 PLANT AUTOMATION AND CONTROL
1.1 DEFINITIONS

1.1.1 Umm-Bab Substation # 2 (KAHRAMAA)

Is the 132/33 kV Substation of Qatar General Electricity & Water Company (KAHRAMAA) located near Umm-Bab.

1.1.2 KAHRAMAA

Is Qatar General Electricity & Water Company

1.1.3 Cement Plant-5

Is the cement plant expansion project of capacity – 5000 Ton Clinker / Day under construction. FCB

1.1.4 E-14

Is the 33/6.6 kV Substation which will be installed at Owner site to receive the incoming power supply to the Cement Plant-5.

1.1.5 E-24

Is the 6.6 kV distribution station, which will be built by the general contractor of the Cement Plant-5.

1.1.6 Contractor

Supplier of this tender.

1.1.7 General Contractor

- General Contractor of the Cement Plant-5.

1.1.8 Owner

Qatar National Cement Company (QNCC).
1.2 INTRODUCTION

The owner has placed an order for the installation of a New Cement Production Line capable of producing 5000 T/D clinker on a turnkey basis with the following General Contractor.

FCB CIMENT
FRANCE

The New Cement Production Line will be fed with electrical power from Umm-Bab Substation # 2 (KAHRAMAA).

The owner has to derive his supply from Umm-Bab Substation and run a new supply line to the New Cement Plant-5, where a 33 / 6.6 kV – incoming Transformer station has to be built.

The layout, single line diagrams and the typical general arrangement drawings included in the Tender Document shall serve as a guide-line to be followed as closely as possible by the Tenderer and must be elaborated in contractor’s engineering design. The final arrangement of the equipment to be designed by the Tenderer shall consider the space requirements for access for erection and maintenance as identified in the drawings and Tender Document as minimum requirements.

The Tender shall be elaborated on this basis and in accordance with the specifications and drawings forming an integral part of this Tender Document.

1.3 CONCEPT OF POWER SUPPLY

The maximum power required for the Cement Plant is estimated to be approx. 28 MVA (local site conditions). The system installed however is laid-out for a standby feed, thus 2 power cables supply lines and 2 Transformers (30 MVA each) are foreseen, working standalone under normal operating conditions.

Umm-Bab Substation # 2 (KAHRAMAA) has the required Transformation equipment to transfer 132 kV into 33kV and through 33 kV indoor Switchgears for further distribution into the area of Umm-Bab.

The exit from Umm-Bab Substation # 2 (KAHRAMAA) shall be by 33 kV cables up to the connection to the incoming terminals at E-14
At the Cement Plant -5 site the 2 power supply cables will terminate into indoor circuit breakers and thereafter onto the 2 transformers of 30 MVA capacity (under site conditions). All the switchgears will be installed indoor and Transformers will be installed outdoor with a sun shed and oil sump pit and firewall.

The new 33/6.6 kV Transformer station **E-14** will be built adjacent to the foreseen 6.6 kV distribution station **E-24**. The 6.6 kV equipment is arranged as indoor station.

From the 6.6kV distribution station **E-24** all departments electrical stations are supplied with power at a level of 6.6 kV. These individual departmental electrical stations distribute power directly to 6.6 kV consumers (i.e. large drives) and to 6.6 kV / 415 V Transformers for the feed to Low Voltage Main Distribution Centers, MCC's and other LV – consumers. (E-24 substation is in scope of general contractor)

### 1.4 PLANT AUTOMATION AND CONTROL

The Cement Plant process will be controlled by a modern type plant automation and instrumentation system (SIEMENS PCS 7). All control and plant automation systems will be located in the Cement Plant Central Control Room (CCR).

The Contractor shall provide for monitoring signals of the 33 / 6.6kV distribution network by the automation system to the new cement plant Central Control Room. Status as well as alarm conditions shall be monitored; however no operations will be handled from this automation system. Operation shall be local at the 33/6.6 kV **Substation E-14**.

Status as well as alarm conditions of the 33 kV Switchgear (On/Off/Earth/Trip etc.) shall be monitored at NCC (Through Umm-Bab KAHRAMA Substation # 2). Energy meter signals (pulses) also shall be transmitted to ‘NCC/DGCC’.

Telephone connection between the Umm-Bab Substation # 2 & NCC/DGCC and the 33/6.6kV – **Substation E-14** shall be installed by the Contractor for communication purposes.
2. SCOPE OF TENDER

TABLE OF CONTENTS

2.1 GENERAL
2.2 SCOPE OF SUPPLY
2.3 SCOPE OF WORK
2.4 DEFECT LIABILITY
2.5 EXECUTION OF WORK
2.6 TRAINING
2.1 GENERAL

The scope of tender includes on a full turn-key basis Design, Engineering, Manufacture, Assembly, Inspection, Testing at Manufacturer’s Works before Dispatch, Packing, Supply, Delivery at Site, Including Insurance During Transit, Subsequent Storage, Erection and Commissioning of Power Transformers With Associated Switchgears, including Supply & Erection of Substation Steel Structures, Construction of related Civil Works and installation of the complete system from the 33 kV circuit breaker terminals at the Umm-Bab Substation # 2 (KAHRAMAA) up to the inlet terminals of the 6.6 kV incoming circuit breakers at the Cement Plant–5 (E-24) complete with all required installation works, commissioning, testing and putting into normal operation.

The scope includes the 6.6 kV cables, cable trench, cable trays and termination between transformer secondary and E-24 sub-station (respective incomer panels).

The scope of tender furthermore includes the design and supply of all required protection and safety equipment the lighting system, Earthing, Lightning system, fire alarm system etc. for the station and fencing of the complete switchyard all as set up by the KAHRAMAA standard specifications and technical requirements.

Also included is all required design, engineering and coordination work with all parties involved.

Sufficient margin / openings shall be kept for extending the panels at both 33 kV and Control Panel rooms.

2.2 SCOPE OF SUPPLY

Introduction

The scope of supply comprises all necessary equipment and installations from the HV-switchgear cable terminals of the 33kV indoor-equipment of the 132/33kV Umm-Bab KAHRAMAA Substation # 2 up to the 33/6.6kV Transformers including all equipment and devices such as power transmission cables 33kV and 6.6 kV cables, disconnect Switches, circuit breakers, earthing switches, current and potential transformers, power and control cables, devices for metering, control interlocking, protection and auxiliary equipment complete with all installation work including civil works, structural steel works, erection, testing, commissioning and handing over and guaranteeing of such works.
Details of Scope of Supply

<table>
<thead>
<tr>
<th>Item #</th>
<th>Qty.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>33 kV &amp; 6.6 KV Cables single core cables</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>2 Pcs Power Transformers 33 / 6.6 kV, 30/35 MVA with 10% impedance</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>2 Pcs Neutral resistor</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>1 set of 33 kV switchgear (2 Nos. incoming, 2 Nos. Outgoing feeders and one Bus couplers)</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Control &amp; Monitoring Panel</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>AC &amp; DC distribution system and battery charger &amp; 5 KVA UPS incl. maintenance free Batteries.</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Low Voltage and Control Cables</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Grounding materials</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Surge arresters</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Steel Structure</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Fire alarm and firefighting system including fixed CO2 extinguishers</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Safety equipment</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Lightning protection system</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Complete lighting system</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Air-conditioning (Package type Unit)</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>Grounding of Substation</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>Interfacing equipment including all accessories</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td>Spare part list and spares for 05 years</td>
</tr>
<tr>
<td>19</td>
<td></td>
<td>Documentation (05 Sets Hard Copies + soft copy)</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>Any other Accessories required</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>Telecommunication/SCADA system for transmission all alarm and monitoring signals to NCC through Umm-bab primary sub-station.</td>
</tr>
</tbody>
</table>
2.3 SCOPE OF WORK

The scope of work includes the following:

2.3.1 Design, Engineering, Project Management, System analysis and Network Studies including relay co-ordination etc.

2.3.2 Interfacing between DGCC / Umm-bab Substation and Owner Substation (SCADA System).

2.3.3 Transportation

2.3.4 Civil Works

2.3.5 Cable Laying

2.3.6 Erection

2.3.7 Testing

2.3.8 Commissioning

2.3.9 Training

2.4 DEFECT LIABILITY

The contractor shall be kept responsible for any defect of all equipment and installations for a period of 400 days from date of provisional acceptance certificate as mentioned in the general conditions.

2.5 EXECUTION OF WORK

DESIGN, ENGINEERING, PROJECT MANAGEMENT, SYSTEM ANALYSIS, NETWORK STUDIES, TRAINING, RELAY CO-ORDINATION, COMMISSIONING AND SUPERVISION OF INSTALLATIONS MUST BE CARRIED OUT COMPLYING WITH KAHRAMAA STANDARD SPECIFICATIONS AND TECHNICAL REQUIREMENTS BY ORIGINAL MANUFACTURER OF THE SUPPLIED EQUIPMENTS.
2.6 TRAINING

- Imparting training to owner’s 02 engineers for all the equipment at sub-station shall be included in the scope.

- The scope includes training of at least two owners engineers should be trained at original equipment manufacturers place for protection Relays, 33 kV GIS switch gear and SCADA system.

- Owners Engineers should be involved from design stage to commissioning stage at Qatar as well as abroad.

- All costs regarding training, including air tickets, boarding & lodging will be borne by contractor.
3. LOCAL CONDITIONS

TABLE OF CONTENTS

3.1 UMMBAB SITE

3.2 INFRASTRUCTURE AND COMMUNICATION

3.2.1 Port
3.2.2 Roads
3.2.3 Air Transport
3.2.4 Telephone & Telex

3.3 UMMBAB AREA

3.3.1 General Geographical Situation
3.3.2 Meteorological Data

3.4 PLANT SITE

3.4.1 Water Supply
3.4.2 Power Supply
3.4.3 Fuel
3.4.4 Camp and Accommodation of Staff
3.4.5 Soil Characteristics

3.5 MISCELLANEOUS

3.5.1 Currency
3.5.2 Cost of consumables
3.1 UMM BAB SITE

The site of the New Production line is located near Umm Bab and is about 75 km West of Doha and about 09 km from the seacoast. The Plant–I is about 04 km from the Plant–II towards the sea, Cement Plant - III is located at about 100 meter from Cement Plant -II towards east & Plant -IV will be located at about 200 meters from Cement Plant -III towards east. Plant -V will be located at about 200 meters from Cement Plant -IV towards east.

3.2 INFRASTRUCTURE AND COMMUNICATION

The site of the New Production line is located near Umm Bab and is about 75 km West of Doha and about 09 km from the seacoast. The Plant–1 is about 04 km from the Plant–2 towards the sea & Cement Plant-3 will be located at about 100 meter from Cement Plant -2 towards east.

3.2.1 Port

The port is located at Mesaeed, which is approximately 100 km East from the Plant.

Port at Doha can be considered as an alternative for small shipments.

3.2.2 Roads

Road transportation in the State of Qatar is generally good and shall follow Qatar’s traffic rules. The asphalted main roads are suitable for movement of heavy trucks.

3.2.3 Air Transport

Doha airport is the only one in the State of Qatar.

The Airport at Doha is connected to the international air system and can be directly reached from any major city.

3.2.4 Telephone and Telex

Telephone and Telex services in the State of Qatar are linked to the international system.
3.3 UMM BAB AREA

3.3.1 General Geographical Situation

The proposed plant site is off DOHA-UMM BAB highway as shown in Appendix IV-1. It is at an altitude of about 12-15 m above sea level.

The approximate road distances from the below mentioned cities to the plant site are:

- 30 km from Dukhan
- 75 km Doha
- 80 km from Umm Said.

3.3.2 Meteorological Data

The climate of the Umm Bab area is characterized by the following meteorological data:

3.3.2.1 Temperature

- Maximum 50°C
- Minimum 4°C
- Annual average 22 to 32°C
- High 35 to 42°C May to October
- Low 12 to 16°C December to March

3.3.2.2 Relative Humidity

- Maximum 100%
- Minimum 4%
- Annual average 40 to 70%
- High 84 to 88% December to March
- Low 20 to 27% April to July

3.3.2.3 Rainfall

- Maximum 300 mm
- Minimum 10 mm
✓ Annual average 75 mm
✓ High (Monthly) 12 to 16 mm Dec. to March
✓ Low (Monthly) 0 to 3 mm June to November
✓ Max. 24 Hours 80 mm

3.3.2.4 Atmospheric Pressure (Stress)

The mean sea level pressure is around 1’010 hPa (1hPa = 100N/m²).

3.3.2.5 Wind

✓ Speed maximum 100 km/h
✓ Design Basis 140 km/h

Sandstorms on an average are experienced 5 to 6 times in a year, mainly between March to July.

Prevailing winds are from NNW direction.

3.3.2.6 Earthquakes

The Arabian Peninsula is generally regarded as a stable mass and there are no known records of earthquake tremors in the vicinity of the Plant site area.

Based on the above, the Umm Bab area can be considered as an area of moderate intensity

For design assume intensity IV on Modified Mercally (MM 1931) Medvedev Sponheuer / Karnik (MSK 1964) scales:

✓ Horizontal ground acceleration \( a_h = 0.06 \) g
✓ Vertical acceleration \( a_v = \frac{1}{2} a_h \)

Note: Only wind or earthquake is acting.
3.4 PLANT SITE

3.4.1 Water Supply

The provision of water for the Contractor’s camp, the construction, erection and commissioning belongs entirely to the responsibility of the Contractor.

3.4.2 Power Supply

The Contractor is required to provide his own temporary infrastructure for power generation and distribution during construction and erection. The temporary installation shall fully comply with the relevant standards, especially with regard to safety aspects. Temporary cable could be extended from existing Plant -2 at the cost of the contractor. Power consumption will be charged as per KAHRAMAA rates.

3.4.3 Fuel

The provision of fuel for construction, erection and commissioning belongs to the responsibility of the Contractor.

3.4.4 Camp and Accommodation of Staff

The Contractor is entirely responsible for accommodation, catering, health care and transportation requirements of his and his Sub-Contractor’s personnel employed for execution of the works.

The treatment and disposal of all waste, sewage and wastewater during construction, erection and commissioning belongs entirely to the responsibility of the Contractor.

3.4.5 Soil Characteristics

Detailed geo-technical investigation shall have to be carried out by the Contractor in the area of the New Sub-station. However, as a preliminary guidance, the maximum ground bearing pressure at a depth of not exceeding 1 meter can be considered as 4 kg/cm².

Ground-water is encountered at about 8 – 14 m depth (Brackish water) (to be verified by contractor)
3.5 MISCELLANEOUS

3.5.1 Currency

The national currency of the State of Qatar is the Qatari Riyal (QR). There are no restrictions regarding convertibility of the Qatari Riyal into other currencies.

The local currency exchange rate fluctuates depending on market conditions.

3.5.2 Cost of Consumables

As per rates applicable in the State of Qatar.
4. DESIGN CRITERIA

TABLE OF CONTENTS

4.1 BASIC REQUIREMENTS
4.1.1 General
4.1.2 Plant Classification
4.1.3 Materials / Workmanship
4.1.4 Maintenance and Safety Aspects
4.1.5 Quality and operational Aspects

4.2 REQUIREMENTS FOR ELECTRICAL INSTALLATION
4.2.1 Applicable standards
4.2.2 Frequency and Voltage Levels
4.2.3 Control Devices
4.2.4 Power, Control Cabling, Cable Installation Material
4.2.5 Lighting
4.2.6 Air Conditioning
4.2.7 Earthing
4.2.9 Type Tests
4.2.10 Name Plates / Labels

4.3 REQUIREMENTS FOR CIVIL AND STRUCTURAL WORKS
4.3.1 Responsibility for Design and Supply
4.3.2 Scope of Civil and Structural Work
4.3.3 Materials and Applicable Standards
4.3.4 Design Loads
4.3.5 Excavation and Backfilling, Earthworks
4.3.6 Foundation Design
4.3.7 Concrete
4.3.8 Structural Steel
4.3.9 Buildings & Structures
4.3.10 Electrical Rooms & Facilities
4.3.11 Switchyard & Fencing
4.3.12 Roads & Places
4.3.13 Fire Prevention
4.3.14 Lightning Protection
4.3.15 Master key System
4.3.16 Clearance of site on Completion
4.1 BASIC REQUIREMENTS

4.1.1 General

All equipment to be offered shall be new, of robust design and manufactured and shall correspond to modern standards of technique. Throughout the Project such equipment has to be selected which has a high degree of availability in operation and requires low maintenance.

**All the main equipments shall be from European origin.**
The design criteria employed throughout shall be based on heavy-duty industrial application in dusty environments.

All equipment and material shall be of a standard, equal or better than specified herein or as laid down in the latest relevant international standards.

The equipment and materials shall be suited to the local climatic conditions, the high sun intensity, the large temperature range and the relative humidity as well as the prevailing dust emission on site.

4.1.2 Plant Classification

For proper identification of all major equipment, the Contractor is required to adapt the cement plant classification system given by the Cement Plant-4 Project. However this is limited to the main components only.

4.1.3 Materials / Workmanship

All materials, welding and fabrication shall comply with applicable standards.

The metric system (SI-units exclusively) will have to be applied for design (all specifications, drawings and manuals) and for manufacturing of all equipment as well as Civil Works and steel structures.

National Qatari Standards and KAHRAMAA regulations will have priority over the above Standards for application regarding construction, erection, safety and environmental aspects.

All materials shall be of the highest quality of their respective kinds and suitable for their application. The Contractor shall supply material and workmanship in accordance with the best and most modern practice.
All components shall be newly manufactured from identified sound material, completely free from all imperfections such as cracks, flaws and inclusions. Where reference is made to codes of practice and / or standards the latest amendments thereof shall be deemed to be incorporated.

4.1.4 Maintenance and Safety Aspects

4.1.4.1 Supporting Structures, Safety Accesses

The Contractor shall provide all supporting structures, maintenance platforms, stairs and safety accesses which form part of the equipment and are required for the support of the proper and safe access to his equipment for the purpose of inspection and maintenance of the plant as well as emergency exit ways as required by the applicable regulations.

4.1.4.2 Safety

All equipment to be offered shall be provided with adequate safety devices according to international standards.

Safety guards will be used at all possible points of physical contact with live parts.

4.1.5 Quality and Operational Aspects

4.1.5.1 Painting

All steel and cast surfaces of the equipment and its supporting steel structures shall have a surface preparation, painting and color coding according to the table 1.5.2 and 1.5.3.

In case where there is no seaworthy packing involved, the painting must give a protection against corrosion during sea transport.

The painting necessary during and after erection (touch-up painting work) will be done by the Contractor on site through paint specifications. He shall deliver accordingly sufficient painting material.

The following particulars shall be strictly followed for all site painting work:

- Touch-Up painting Works shall recover all damages on the painted surface of the equipment caused during the ocean freight, inland-transportation, erection and commissioning / initial operation (heat).
Surface treatment shall be satisfactorily carried out prior to commencement of painting.

An addition of any other dilution than required by paint supplier is not allowed.

Storing, transporting and opening of the paint, dilution and drying oil, which are inflammable or emitting harmful gases, shall be carried out in accordance with the valid regulations.

The touch-up painting shall not deviate from the initial paint as per specification.

### Paint Specification

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Steel Structure</th>
<th>Steel Plate Equipment</th>
<th>Standard Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Category</td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td></td>
<td>Plate temperature</td>
<td>Ambient</td>
<td>&lt;= 120°C</td>
</tr>
<tr>
<td>Cleaning</td>
<td></td>
<td>SA2.5, According to British Standard (S 19 05 5900)</td>
<td>Manufacturer Standard</td>
</tr>
<tr>
<td>Prime coat</td>
<td></td>
<td>Rich Zinc epoxy premier 75µm one coat</td>
<td>Rich Zinc epoxy premier 75µm one coat</td>
</tr>
<tr>
<td>Cleaning</td>
<td></td>
<td>Cleaning, Brushing, and repairing before application of finish coat</td>
<td>Manufacturer Standard</td>
</tr>
<tr>
<td>Finish coat</td>
<td></td>
<td>Finish epoxy 50µm one coat</td>
<td>Finish epoxy 50µm one coat</td>
</tr>
</tbody>
</table>

### Color code for Finishing Painting of the Equipment

<table>
<thead>
<tr>
<th>Object to be painted</th>
<th>Color</th>
<th>RAL-No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>33kV – Switchgear</td>
<td>Grey</td>
<td>7032</td>
</tr>
</tbody>
</table>
Transformers Grey 7032
Fence Galvanized
Poles Grey 7032
Switchgear Control Panels Grey 7032

4.1.5.4 Special Tools

Special tools, software, interface required for the operation or maintenance of any piece of equipment shall be supplied with the equipment. These tools may be used during the erection of the equipment provided that they are handed over to the Owner undamaged & in good condition or shall be replaced by the Contractor without cost to the Owner.

4.1.5.5 Bolts, Screw Threads, Holding-Down Bolts and Base Plates

All bolts and nuts shall have metric threads only.

All bolts, nuts, washers and securing devices for the proper assembly of the equipment shall be included. This means also all foundation bolts and fastening devices required for the attachment of the equipment to the steel structure or concrete works or foundations.

4.1.5.6 Auxiliary Materials

Auxiliary materials such as lubricants, cooling medium, isolating media etc. required for initial operation until start of commercial operation and handing-over shall be provided by the Contractor.

4.2 REQUIREMENTS FOR ELECTRICAL INSTALLATION

4.2.1 Applicable Standards

The design and construction of the equipment and all its components and accessories shall confirm with the practices outlined in the latest editions and supplements of the following standards:

1. The requirements as specified in the document.
2. The local standards and regulations (KAHRAMAA)
4.2.2 Frequency and Voltage Levels

The frequency of the power supply shall be 50 Hz.

The different voltage levels are:

- Incoming Power from the KAHARAMAA network: 33kV/3 ph
- MV-Distribution: 6.6 kV / 3 ph
- Low Voltage motors / distribution: 415 V/3 ph + n + E
- Lighting and socket outlets: 240 V/1 ph + n + E
- DC Control: MV- switchgear: 110 V DC
- Analogue signals: 4-20 mA (2-wire), 24 VDC

4.2.3 Control Devices

Basic Design Criteria of Field Control Elements

Field control elements shall confirm with the following general design criteria:

a. Dust proof Conform to NEMA 12/IP65
b. Water proof Conform to NEMA 4/IP65
c. Wiping action on contacts (self cleaning) encapsulated contacts are preferred.
d. Housing preferably made of metal or equivalent strong material. Covers to be fitted easily, screws to be secured. Electronic equipment to be suitably protected against radio interference (walkie-talkie).
e. Resistant against vibration (contact pressure).

f. Suitable for ambient temperature of –20°C to +70°C.

g. Connections
   - Sensor type field elements to be supplied with min. 1.5 m long extension cable.
   - All others: lug-type connections.

h. Mounting
   - By screws, mounting holes to be sealed. Adequate mechanical protection to be included.

4.2.4 Power, Control Cabling, Cable Installation Material

All cables shall be dimensioned according to the load of the connected equipment and the short circuit conditions of the connected network. The current carrying capacity of the cables shall be in full compliance with standards and in consideration of de-rating factors for ambient temperature, laying method and cooling conditions etc. as per KAHRAMAA / IEC [Site conditions to be considered for duration factor]

The color of the cables shall be standardized throughout the plant to distinguish between the voltage levels/function of the cable.

Low voltage power cables shall be unarmored of the type XLPE for indoor use only (with in sub-station) and for outdoor use, these should be armored of the type XLPE.

High and medium voltage cables installed outdoor shall be as per KAHRAMAA standard & shall be able to carry full load at site condition and lay in trenches within the station area.

Cables laid in trenches shall be at least 1 m deep on a sand bed and 200 mm sand covering, protected by concrete tiles.

Cables in ducts shall occupy max. 50% of the volume of the duct. Number of ducts installed shall be not less than 3 and shall have 100% spare units.

Cable routes shall be marked by reinforced concrete marker as per 4.3.10.4

Neutral and grounding wires shall not be used for any other purpose. All cables shall have copper conductors with proper grade insulation.
Extra low voltage cables shall be color coded and follow the same sequence at both cable ends and throughout the all installation.

4.2.5 **Lighting**

The complete switchyard shall be lighted with an average illumination level of 100 Lux. At maintenance, measuring and operating points 300 Lux shall be foreseen.

4.2.6 **Air Conditioning**

All electrical rooms shall be cooled by package type A/C units (100% standby). A room temperature of 20°C has to be maintained at 50°C Ambient.

4.2.7 **Lightning Protection**

Lightning Protection to be arranged by the contractor as per IEC / KAHRAMAA specification.

4.2.8 **Earthing**

Earthing and grounding of the electrical equipment shall be provided.

Lightning protection earthing shall be separate from the grounding of electrical equipment / Sub-station earthing.

4.2.9 **Type Tests**

All major electrical equipment included has to conform to the relevant standards and shall have passed the required type tests. Test certificates shall be provided.

4.2.10 **Name Plates / Labels**

The following metal plates of corrosion resistant material or any other equivalent as per standard (min. 1.6 mm thickness) and suitably sized shall be fitted to the equipment:

- Manufacturer’s label with the usual technical data
- Plate of reasonable size having the equipment number good readable engraved according to the final coding as per Plant classification.
Instruction plates, as far as necessary for safe operation, safety and warning notices shall be in English and Arabic languages.

4.3 REQUIREMENTS FOR CIVIL & STRUCTURAL WORKS

4.3.1 Responsibility for Design and Supply

Notwithstanding any omission or interference of limits from the owner’s specifications, the Contractor shall provide everything required for the proper construction, completion and maintenance of the works, allowing for all incidental and contingent expenses and risks of every kind.

The contractor shall be entirely responsible for the Civil and structural design, stability and sufficiency of the works.

All civil works shall be in accordance with the Qatar National building Specification.

The contractor is entirely responsible for the satisfaction of the general design criteria and the provision of adequate safety margins for all conditions of loading involved.

Drawings, calculations and diagrams covering all aspects of the design shall be furnished by the contractor.

4.3.2 Scope of Civil & Structural works

The contractor shall be held responsible in any case for the complete and expert design and execution of all civil and structural works according to the agreed time schedule. He is deemed to have thorough knowledge of the local conditions, the existing buildings and structures and the nature of the works to be executed. The scope of the civil and structural works (in the following referred to as “Civil Works”) includes but is not limited to the following.

4.3.2.1 General Scope

All Civil work in connection with the construction work as the site installations, civil substructures below ground level, (reinforced) concrete structures and masonry, interior and finishing works, building equipments for installations and environmental works as specified herein and as necessary for the completion of the works.
All structural steel and iron works as fabrication, delivery, rust protection, erection or placing (incl. all appertaining fixing and linking materials as bolts, anchors a.s.o.), accompanying works as gates, doors, all in accordance with the respective specifications and as necessary for the completion of the works.

The complete detail design for structural and infrastructural as well as all required and necessary survey, investigation, testing and guarantee of the works until final acceptance respective the expiry of the liability.

4.3.2.2 Particular scope of works

- General site installations for civil works and electrical installations. The labor camp, material storages, distribution system for power requirements during construction.
- Excavation and back filling works as required.
- Construction of all structures necessary for the new cable installation as well as for the 33/6.6kV – transformer station.
- All infrastructure works including all necessary general site preparations. Connections to the existing systems, roads and places, lighting as well as restoration of the whole site upon completion of the works.

4.3.3 Materials and applicable standards

The structural criteria set forth herein have been prepared for use in the design of all structures. The purpose of this specification is to facilitate the work of the designer, provide uniformly of design effort and to provide data and design criteria, which may otherwise be overlooked.

All materials used throughout the works shall be of the best quality and shall conform in all respects with the Qatar specs (QNBS) wherever applicable otherwise as per standards / specification at Qatar.

In addition any relevant regulations of the competent local authorities have to be considered.

All workmanship shall be executed in accordance with recognized good practice and in accordance with the appropriate and actual codes of practice applicable to the particular category of work.
The requirements as special loading, peak values for temperature or wind, temporary strain, bad soil etc. should be considered according to local conditions (part 3 of volume 2) and design of the pertaining equipment. Sufficient allowance has to be made to avoid the influence of settlements on sensitive equipment. Where necessary fire prevention measures must be considered, e.g. fire barriers.

For design and calculations the SI –System shall apply.

4.3.4 Design Loads

4.3.4.1 Live Loads

- Electrical control panel areas and control rooms: 7kN/m² (1* - Includes equipment load)
- Stairways: 5kN/m²

Minimum or concentrated load of 500 kg.

4.3.4.2 Wind Loads

All structures shall be designed to withstand wind pressure resulting from the max. Wind velocity of 140km/h at ground surface (Part 3: “Local Conditions”) in accordance with applicable Standard.

4.3.4.3 Earthquake Loads

All structures shall be designed to sustain the seismic load specified in Part - 3, Local Conditions.

4.3.4.4 Load Combinations

The following load combinations shall be considered:

a. Dead load + live load: No increase in allowable stress according to values given in the relevant BS.

b. Dead load + live load + wind earthquake: 1/3 increase in allowable stresses according to values given in the relevant BS.
c. Dead load + wind or earthquake: 1/3 increase in allowable stresses according to values given in the relevant BS.

Wind and earthquake loads need not to be assumed to act simultaneously on structures.

4.3.5 Excavation and Backfilling Earthworks

Excavation shall be carried out in accordance with the actual local conditions. Excavation in open cut shall have stable side slopes or be properly supported.

For the safety of excavating operation temporary fences around dangerous excavation sites shall be erected and maintained.

No excavation shall be filled in or covered with concrete until the sub-soil has been inspected, any necessary tests carried out.

All general filling shall be carried out regularly and due allowance made for shrinkage and settlement. The ultimate finished surface shall be according to specified levels and profiles after consolidation.

Filling shall be done in layers not exceeding 0.3 m and thoroughly compacted to a minimum dry density of 95% of the maximum density according to the standard proctor test (ASTM D-698/BS 1377). No material shall be used for backfilling unless approved by owner. All material rejected by the owner shall be removed from the site at the Contractor’s expenses.

The excavations of any permanent works shall be kept dry and all water arising from rain, the sub-soil or from any other cause shall be pumped away. All slopes shall be designed to withstand erosive action.

4.3.6 Foundation Design

For foundation design the design criteria from the geo-technical investigation shall govern.
Sufficient allowance has to be made to avoid injurious influences of settlement differences on sensitive equipment, plant operation and neighboring buildings.

For preliminary design, allowable bearing capacity at –1 m level may be considered as 4 kg/cm².

Before concreting foundations, any test deemed necessary or particularly ordered by the Engineer shall be carried out.

4.3.7 Concrete

4.3.7.1 Cement and Concrete

Cement and concrete shall be obtained from the locally installed facilities and shall follow the requirements and standards set out for the main civil contractor.

The quality of concrete shall comply with the requirements specified in QNBS (Qatar National Building Standards). The testing procedure shall follow the standards.

Concrete structures below ground level or elsewhere where required by the Engineer shall be designed with sulphate resisting cement (SRC and adequate space between the concrete surface and any reinforcement. The contractor has to warrant their being proof to aggressive subsoil. All concrete work under ground level shall be painted by two coats of bituminous paint, cover by Polyethylene sheet 1000 and hard board protected (4mm plywood) at least. Materials have to be approved by Engineer.

When temperature rises above 32°C, American Standard ACI 305 (Recommended practice for hot weather concreting) shall be followed for concreting under conditions.

4.3.7.2 Concrete Strength (Pressure)

<table>
<thead>
<tr>
<th>Minimum Cement Content kg/m³</th>
<th>Minimum compressive strength for each 200mm cube kgf/cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean mix concrete</td>
<td>230</td>
</tr>
<tr>
<td>Plain concrete</td>
<td>300</td>
</tr>
<tr>
<td>Bearing Structures</td>
<td>380</td>
</tr>
</tbody>
</table>
4.3.7.3 Reinforcing Steel

Reinforcing steel qualities in accordance with ASTM 615 steel and/or BS 4449, 4482, 4483 and BS 8110 shall be used and shall be supplied from the Qatari Steel Manufacturing Company.

4.3.8 Structural Steel

All design, fabrication and erection of structural steel shall be in accordance with the relevant ASTM and/or BS standards.

4.3.8.1 Painting

All surfaces of iron and steel work shall be treated as follows:

- Sandblasted to degree SA 2.5
- Painting according to table item: 4.1.5.2

The contractor shall take all precautions necessary to prevent dust and dirt coming into contact with freshly painted surfaces.

4.3.8.2 Column Bases

Anchor bolts shall be designed for all conditions of tensions and shear. Provide shear keys if the anchor bolts are inadequate to take the column base shear.

Large column base plate shall be provided with holes for proper grouting.

4.3.8.3 Grating and Checkered plate

All grating shall be hot galvanized. The grating shall have a min. thickness of 30mm and a mesh width of 25 x 25 mm with a sheet thickness of min. 2 mm.

Grating and checkered plate shall be designed according to the specified live loads.
The checkered plate thickness shall be min. 6 mm (¼”).

The surface of the checkered plate shall have good non-slip properties. The necessary supporting structures (corner steel, grooves, etc.) and their fastening shall be provided as well.

4.3.9 Buildings and Structures

4.3.9.1 Lines and Levels

The ground floor level of all buildings shall be at least 200 mm above finished site level. Where necessary (e.g. at doors and gates) appropriate adaptations, such as steps, ramps and the like, have to be provided.

The level of existing buildings shall accordingly be considered.

4.3.10 Electrical Rooms and Facilities

4.3.10.1 Electrical Rooms

All electrical rooms shall be located above surrounding ground level. They shall be closed dust-tight.

All electrical rooms shall be cooled by package type A/C units. A room temperature of 20°C has to be maintained (at an ambient temp. of 50°C). The rooms shall be generously sized and provide spare space for future modifications and additions. The distance between the switchgear panel rows shall not be less than 1.8 m between operation fronts and 1 m off the rear side.

The wall and ceilings in electrical rooms shall be painted by a non-abrasive paint. For a minimum floor quality, the following guide-lines shall apply:

✓ High-Voltage Switchgear rooms furnished with:

a. Heavy duty, antistatic floor type.

b. Walls and ceiling to be plastered and painted with enamel paint.

c. External walls to be plastered only.
d. Doors should be, double skin, 2mm thick each, hinged steel doors with insulation layer in between 5cm thick and provided with panic unlock device and self closer, air tight, dust tight.

e. Windows and louvers should be out of aluminum with fly screen and sample to be submitted for prior approval.

For ease of cable installation, all electrical rooms shall be provided with a cable basement, allowing installation of cable trays. The minimum clear height of this cable basement shall be 2 MTR Access to the basement shall preferably be provided from the outside door, whereby fire barrier functions of access doors required special attention. The cable basement shall be in general extend over the same area as the electrical room and shall be water and dust-tight.

BS and the relevant local regulations shall apply for all aspects of emergency and safe evacuation of electrical areas, e.g. emergency exits, door opening towards the outside, single action unlock of inside door locks (panic unlock device, etc.).

4.3.10.2 Battery Rooms

A separate battery room (e.g. 110V DC power supply) shall be foreseen.

a) The standard of wall and ceiling finish shall be the same as for the electrical rooms.

b) Heavy duty acid resistant floor type.

4.3.10.3 Transformers

All transformers shall be installed outdoors and in individual transformer cells. The transformers shall be cooled by/fans/natural air draught. The transformer cells shall be separated by a fire barrier wall from one side and the remaining three sides should be closed with steel mesh with main and service door for each cell, allowing for erection and later taking out of the transformer for repair, inspection etc.

Oil basins provided underneath the transformers have to be connected by pipe to a common oil sump pit provided outside the fencing. The pit should have a capacity of one transformers oil quantity. Top of the pit to be covered by a RCC Slab with a manhole and a door.
The transformer cells shall be executed and sealed towards other rooms by fire resistant materials.

The transformer cell shall be provided with sun shed.

4.3.10.4 Cable Ducts

For cable duct installations PVC pipes shall be installed. The PVC pipes shall be not less than 150mm diameter and at least 100% spare pipes shall be installed for each kind of cables along each run. The PVC pipes shall be properly positioned and embedded in lean concrete or sand with concrete tiles covers along the entire length prior to the cable installation. At road underpasses, the pipes shall be protected by concrete tiles. Manholes are required at each end of road crossings and for distances not exceeding 60 meters or where the cable run changes direction.

Openings shall be approx. 50 cm above ground level and equipped with a cover to be of rigid design with watertight sealing.

All Cable duct or road crossing underground to adhere to local KAHRAMAA specifications.

Outdoor lighting cables should laid in PVC pipes and can be buried in sand and protected by concrete tiles.

4.3.11 Switchyard and Fencing

The complete Electrical Substation (33kV-switching mechanism and transformers) shall be fenced. At least 15 meters distance is to be maintained between the fence and any installation. The fence shall be of steel wire – Refer: Part –5 – Item: 5.8 (Installation Work)

Lockable access and maintenance doors shall be provided.

The whole area inside the fence shall be covered by suitably sized gravel. Concreted walkways 1200 mm wide shall be provided from the doors to all operating and maintenance positions.

4.3.12 Roads and Places
4.3.12.1 Preamble

The contractor shall provide roads and access places as required by the design. These have to be connected to the roads provided by the Cement Plant –5 General Contractor (FCB France). The road surface shall be exactly the same as for the roads provided in the Cement Plant-5.

4.3.12.2 General

Roads and surfacing shall be in accordance with the relevant technical specifications and codes of practice of the relevant Qatar Standards & Specifications.

Roads and places must be designed for the maximum imposed loads and of such width to suit all vehicles used at the Plant site.

The Contractor has to inform himself about the actual and future vehicle loads, the traffic frequencies and the sub ground conditions of all plant roads and to design the roads accordingly.

All drains, pipes sewers, channels and conduit banks as well as crossing of existing installations shall be completed before the construction of the roads or places is started.

4.3.12.3 Materials and Workmanship

Hard-core shall consist of natural stone broken to pass a 75 to 100 mm ring. It shall be free from dust, rubbish, wood, vegetable or other injurious matter.

Broken stone and chippings shall consist of hard crushed natural stone or gravel of approved sizes.

Rigid pavement of 20cm thick with 8mm steel mesh to be arranged for roads and places with joints (see item 3.12.6).

4.3.12.4 Preparation and Formation

The formation shall be rolled to an even and uniform surface, which shall be parallel to the finished surface of the road or path. Rolling shall be carried out with heavy rollers, carefully adapted to the nature and the condition of the soil. After completion or stabilization (if required) the formation shall yield a C. B. R. equal / larger 15%.
The formation surface design shall allow for effective and permanent drainage during the works.

4.3.12.5 Sub-Bases and Verves

After the formation has been properly made and rolled a sub-base consisting of well-graded natural sands, gravels or rock or mixtures thereof shall be laid and compacted to A.A.S.H.O. class A sub-base in accordance with the local conditions.

Side verges shall be arranged laterally to the wearing courses and confected with width of 2.0 meters.

4.3.12.6 Concrete Surfacing

A 80 mm thick sand layer (max. grain size 16mm) covered with a min. 1000 gauge PE foil shall be placed between sub-base and concrete slab. The slab shall be made of reinforced concrete with a minimum compressive strength of 37 N/mm² in one layer and reinforced with welded steel 8mm wire mats.

The required slab thickness for roads and places shall be 200mm.

The design shall be provided also for all joints. The following max. distances are to be considered:

✓ For dummy joints 5 m
✓ For expansion joints 72 m
✓ For longitudinal joints 5 m

After finishing operations and surface brooming have been completed the exposed surfaces shall be cured by covering the concrete for 24 hours with wet burlap or other approved material, applied as soon as the concrete has hardened and followed by a 7-day curing period of ponding, spraying with an approved curing compound or covering with wet earth, straw, burlap or cotton mats which shall be kept saturated with water for 7 days. Instead of this wet curing procedure, an approved impervious membrane may be applied immediately after finishing the concrete surface.

4.3.12.7 Rain Water Drainage

As a consequence of the scarce rainfalls no storm water drainage is required. Any rainwater shall be led by slope from traffic areas to the neighboring ground where it may evaporate. Structures shall be protected against flooding water.
4.3.12.8  Light Intensity

Sufficient lighting has to be provided for all roads and places in accordance with the respective requirements (as per 4.2.5.).

Complete and sufficient lighting columns, incl. the necessary foundations, connections etc. shall be provided.

4.3.13  Fire Prevention

4.3.13.1  General

The required fire prevention system for the Transformer station shall be included as required by local standards.

4.3.13.2  Fire Fighting

The electrical station shall be furnished with adequate fire fighting system. It shall allow for easy accessibility, must be well marked and indicated and shall consist of:

✓ Mobile fire extinguishers with trolleys of appropriate number size and medium.

4.3.14  Lightning Protection

Appropriate lightning protection system according to KAHRMAA requirements otherwise IEC Standards for such Substation to be installed.

4.3.15  Master key System

A separate master key system to be arranged and supplied for the sub-station (06 SETS To Be Supplied).

4.3.16  Clearance of Site on Completion

Upon completion of the work the contractor shall unrig, take and clear all construction devices and temporary installations as well as all not utilized old foundations, structures and installations.
He has to remove all rubbish, debris and is to clean all floors, walls, roofing, pavings, ledges, gutters, gullies, sanitary fittings, glass on both sides and all other plant equipment and fittings.

The contractor shall leave the works clean and perfect at completion.
5. DESCRIPTION OF ELECTRICAL EQUIPMENT

TABLE OF CONTENTS

5.1 POWER SUPPLY – GENERAL
5.2 132/33KV – KAHRAMAA UMM BAB SUBSTATION # 2
5.3 CABLE TRANSMISSION LINES
5.4 33/6.6 kV – TRANSFORMER STATION E AT CEMENT PLANT-5 SITE
5.5 METERING AND CONTROL
5.6 DC CONTROL POWER SUPPLY
5.7 EARTHING REQUIREMENTS FOR 33KV – STATION
5.8 INSTALLATION WORK
5.1 POWER SUPPLY – GENERAL

✓ All ratings specified are site ratings in Qatar.

✓ Power for the supply of the Cement Plant-5 is supplied at a level of 33 kV from Umm-Bab 132/33kV KAHRAMAA Substation # 2.

✓ All required equipment for transforming power from 132 to 33 kV and distribution at 33kV level at this Substation is provided by KAHRAMAA.

✓ All further required installations for transmission to the Cement Plant-5 and transformation from 33 to 6.6kV is to be provided by the contractor according to KAHRAMAA standard specifications and requirements.

✓ Separate, standard metering system for billing has to be provided at Owner 33/6.6kV – Transformer Station E-14 on the 33kV side or at Umm-bab 132/33 kV KaHRAMAA sub-station#2 as per KAHRAMAA’s requirements. Complete metering equipment and meters to be approved by KAHRAMAA. The technical details of the meters and CT’s shall be forwarded for review by KAHRAMAA prior to the purchase of the equipment calibration of billing meters at site by approved agency shall be include in the contractors scope.

✓ Check metering is to be foreseen at the 33/6.6kV-Transformer Station, E-14.

✓ The 33/6.6kV-Transformer Station – E-14 - at the plant site will be operated and maintained by Owner.

✓ Approval has to be obtained from KAHRAMAA regarding type and specification of all proposed equipment and its installation. The KAHRAMAA standard specifications, technical, safety requirements and approval procedures are to be followed. All the pre-commissioning and post-commissioning calibration /tests at site shall be in the scope of contractor.

✓ The exact location of the Umm Bab 132/33kV Primary Substation is given on the extract of enclosed drawing.

5.2 132/33KV – UMM-BAB PRIMARY SUBSTATION

✓ Typical single line diagram No. UB-2/01 shows the foreseen KAHRAMAA feeders (E/E) arrangement at the Umm Bab 132/33kV KAHRAMAA Substation # 2.
33kV-switchgear equipment and installations will be provided by KAHRAMAA; the exact take-up points for connection of the 2 feeders as specified by KAHRAMAA are the cable terminals of the 33 kV indoor circuit breakers. All required CT’s, cables, trays installation materials etc. have to be provided. Coordination work with KAHRAMAA will be the responsibility of the Contractor.

The feeders will be protected by over-current, differential protection and earth-fault by KAHRAMAA system.

The 132kV-system neutral is directly grounded and the 33kV-system is grounded through an earthing transformer which limits the earth-fault current. The exact value shall be collected from KAHRAMAA.

The KAHRAMAA network is not solidly earthed at 33kV –level.

The fault level at Umm-bab sub-station No. 2 (KAHRAMAA) is as follows:(to be verified from kharamaa)

<table>
<thead>
<tr>
<th>Voltage level</th>
<th>Max. Fault Level (A)</th>
<th>Min. Fault Level (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>132 kV</td>
<td>12563</td>
<td>10655</td>
</tr>
<tr>
<td>33 kV</td>
<td>132 kV</td>
<td>12194</td>
</tr>
<tr>
<td>12563</td>
<td>10655</td>
<td>10582</td>
</tr>
</tbody>
</table>

The rated short time withstand current of the 33kV-switchgear being installed by KAHRAMAA is 31.5 KA for 1sec.

A panel shall be provided (if required) to incorporate all necessary indications (monitoring) and alarm conditions of the 33kV-switchgear at the Cement Plant 33/6.6kV-Station. The panel shall be installed inside 33kV Umm-Bab Substation # 2. All the necessary interfacing cables, hardware and software required for Transmission, all alarm, monitoring signals, MWH, MVAH, V, Freq. etc. (as per KAHRAMAA requirement) from Billing meters, Transmitting to NCC – shall be in the contractors scope. The communication protocol shall be as per KAHRAMAA approvals are required for any change in the protocol.

5.3 CABLE TRANSMISSION LINES

Power will be transmitted to the Cement Plant-5 33/6.6kV-Transformer Station E- 24 through 2 parallel running and parallel operated 2-phase cable systems.

Each transmission line shall be sized to carry 30 MVA (cont.) at an operating voltage of 33kV at site conditions. (after derating).
Cable differential protection is required between the Umm Bab 132/33kV substation # 2 and the 33/6.6kV-Transformer Station E- 14. The required system is to be included. Essentially required data to match the CT-characteristics for this protection have to be obtained from KAHRAMAA & design the system accordingly. (Class ‘X’ CT’s of appropriate rating as per KAHRAMAA).

The foreseen run of the transmission cables shall generally be decided after survey, which will be responsibility of contractor.

It shall be noted that the power transmission cables will cross existing oil pipe lines & roads. Possibly existing local requirements and required authorized permits concerning such runs and road crossing have to be taken into account at the full responsibility of the Contractor.

The cable terminations and jointing shall be included in the scope.

5.4 33/6.6 KV-TRANSFORMER STATION E- AT CEMENT PLANT- 4 SITE

5.4.1 General

Typical Single line diagram QNCC-L5-ELE-001 shows the foreseen distribution at the 33/6.6kV – Transformer Station located at new Cement Plant Site.

The 33/6.6kV-Transformer Station E- 14 shall consist of Pre- assembled 33kV switchgear of type metal-enclosed, metal-clad and SF6 insulated with Vacuum Circuit breaker for indoor installation. 33/6.6kV-Transformer station E- 14 shall include the necessary disconnect switches, earthing switches, over-voltage diverters, circuit breakers, transformers and all required protection, metering, isolating/grounding devices and safety requirements.

The 33kV-indoor switchgear shall be installed in a separately placed station including all required control – and monitoring panels, auxiliary devices such as control voltage distribution panel, battery with charger, lighting distribution, air conditioning etc. The required metering equipment (as per KAHRAMAA requirements) shall be installed in a separate panel located in a separate, lockable room within this station.

The 33 kV-incoming cable lines are terminated at the incoming termination points of the 33kV-switchgears in the Owner Substation.
The transformers shall be equipped with on-load tap changers for automatic voltage regulations (laid out for individual or parallel operation of the 2 transformers) as well as all necessary cables, connectors, wires and installation material. Instrument for indicating both primary and secondary voltage of transformer concerned is to be included on its panel. Air insulated enclosure (cable Boxes) of high IP rating system (e.g. IP 65) should be provided for cables connections at primary HV (33 kV) and LV (6.6 kV) Bushings.

The cables at both side of the Transformer shall be entered vertically from bottom at the respective cable entry boxes.

The transformer shall be of the outdoor type, ONAN, and shall be located adjacent to the already planned 6.6 kV-Distribution Station E-24 of the Cement Plant.

Each transformer shall be installed in an individual block work bay on its own foundation with oil pit. The transformers shall be installed on rails allowing a later removal without the need of dismantling any switchgear OR disturbing the adjacent Transformer. Transformers need to be separated by a fire barrier wall if they are located next to each other. Sun sheds shall additionally protect the transformer.

Oil sump pits is to be according to the details – Refer: Part-5: Item : 4.3.10.3 (Transformers)

Supply & laying of all the cables (6.6 kV) and termination etc. connecting between transformer secondary side and 6.6 kV Switchgear is contractors scope. Supply of 6.6 kV switchgear (E-24 Sub-station) is not in the contractor’s scope (in the scope of owner through M/s. FCB through owner).

Co-ordination work with the supplier (M/s. FCB France) of the 6.6 kV – equipment is part of the Contractor’s responsibility.

All current transformers at the transformer primary and secondary sides as well as all potential transformers shall be included as required.

As per KAHRAMAA requirement neutral voltage displacement protection (two stage stand by earth fault protection for the LV-side of the transformers) shall be included in the scope.

The necessary control cabling (for interlocking, metering and protection purposes) between the incoming 33 kV-side up to the 6.6 kV-switchgear terminals as well as all cabling between disconnect switches, circuit breakers, transformers etc. (e.g. for protection and control, etc.) shall be included.
The complete switchyard for the 33/6.6kV-equipment shall be fenced with barbed wire on top and as required by Qatari law and regulations, the yard to be sufficiently lighted.

Protection concrete units to be arranged around the fence.

Lockable access doors (equipment and additional man-doors) shall be installed to allow removal of equipment without removing the fence.

The complete switchyard shall be covered with suitable sized gravel.

Concrete walkways shall be provided to all operating and maintenance places.

The entire power distribution system (HV, MV and LV) shall be designed to guarantee selective fault isolation, isolating a faulty circuit from the remainder of the electrical system and thereby eliminating unnecessary power outages. The necessary coordination work (between 132 kV level to 6.6 kV) to be included.

Installation of telephone communication between owner sub-station to KAHRAMAA to NCC shall be included (as per KAHRAMAA requirement) either point to point Contact telephone or separate public telephone line (Q-Tel).

5.4.2 Operation Mode, Etc.,

The system shall be designed to transmit 30 MVA on each feeder, (see drawing 10168/BS/104). In the normal operation condition all the bus couplers shall be in open position.

The system also shall be designed to operate the transformers individually or in parallel at secondary (6.6 kV) side and shall be designed in such a way that only one Neutral ground resistance (NGR) should be in circuit at the time of parallel operation.

In case of emergencies or maintenance to one of the transformers or supply lines, a certain flexibility to operate the system is given by operating the relevant disconnect switches. Disconnect switches can only be operated at no load, i.e. any required interlocks to guarantee such operations shall be included.
The system shall be arranged so as to allow operation without the necessity to contact KAHRAMAA for operation assistance. Any required interlocks (e.g. for operation of earthing switches ES1/ES2, see drawing QNCC-L5-ELE-001) shall be realized by providing the necessary interlocks between the respective equipment.

Interface signals (potential free contacts) shall be made available at NCC/DGCC (KAHRAMAA) for Control, monitoring and interlocking purposes. The necessary signal transmission shall be included.

All necessary position indications of the equipment (on/off/earth) shall be transmitted to the KAHRAMAA - NCC /DGCC and may be used for interlocking and monitoring by KAHRAMAA as required. The necessary coordination works with KAHRAMAA have to be arranged by the contractor.

Interlocking of the earthing switches ES1 and ES2 shall be arranged as follows:

* To prevent closing of Owner earthing switches onto an energized cable.
* To prevent closing of KAHRAMAA circuit breakers if earthing switches are connected to ground.

### 5.5 METERING & CONTROL

A power distribution monitoring, operation and control panel for the 33kV-switchgear disconnect switches, circuit breakers and transformer shall be provided.

This panel shall be installed in separate room inside the 33kV-Substation E-14 building at the Cement Plant site.

From this panel it shall be possible to operate, control as well as to monitor all 33 kV-equipment and the transformers. The switching status of all switchgears, transformer tap changers and disconnect switches shall be remote indicated and controllable from this panel.

It shall further contain all required protection relays (e.g. differential protection for cables and transformers) and devices for the 33kV-switchgear and transformers including tap change control etc. and shall provide detailed alarm indication of the 33 kV-equipment and the transformers.
✓ Local Alarms of Audible & visible with flasher shall be provided at metering and control panel.

✓ The necessary control— respective protection interface to the 6.6kV-switchgear and monitoring 6.6 kV side Voltage / frequency etc. shall also be included in this panel.

✓ Provision shall be made to handle all alarms in the data logging system of the Cement Plant Control System. It shall furthermore be possible to provide all relevant information of the 33kV-power distribution system so as to allow monitoring in the Cement Plant Control Room (“Utility-System” Control console). The required hardware like interface and communication cables repeaters etc. shall be included.

✓ Scope should include all the coordination jobs with control room data logging system supplier / Owner.

✓ The required metering equipment for billing purpose shall be installed in a separate panel located in a separate and lockable, air-conditioned room within the 33kV-Owner substation or at Umm-Bab 132/33 kV Substation #2 (KAHRAMAA) - as per KAHRAMAA’s requirements.

✓ This metering system shall follow KAHRAMAA requirements and shall include individual as well as summation metering of kWh, kVAh and kVARh consumption. The metering class to be 0.2S

✓ The billing meter information like MWH MVAH etc. (as per KAHRAMAA requirements) shall be transmitted to NCC/DGCC through Umm-bab KAHRAMAA Sub-station # 2.

✓ Note: An Auxiliary transformer 100kVA, 6.6kV/415V, is included with the 6.6kV-switchgear (Genral contrctor). It is preferred that auxiliary power possibly required for the control and/or operation of the 33kV-equipment shall be obtained at a level of 415V from this source. The required capacity shall be indicated. UPS shall be provided to feed control & monitoring panel.

✓ The L. T. cable connecting between the Aux. transformer 415 V side at E- 14 A. C. Distribution Board is in contractors scope.

5.6 DC CONTROL POWER SUPPLY & UPS

✓ The switchgear shall be complete with one 110V DC control power supply, including battery rack, charging equipment a distribution panel and a 5 KVA UPS.
The equipment shall be installed in the separate battery room within the 33kV – station E-14 building.

5.7 EARTHING REQUIREMENTS FOR 33KV-STATION

- The Qatari local earthing requirements as applied by KAHRAMAA for such transformer stations have to be followed by all means; reference is made to the IEC & IEEE Standards.
- In addition the regulations as stated in “KAHRAMAA – Wiring Regulation Manual” have to be followed.
- The 33/6.6kV-transformer neutrals shall be earthed through an earthing resistor in order to limit the fault current to a value suitable to a safe limit as per the standards. This will provide an optimum design of the system without adversely affecting the protection system performance under earth fault conditions. In order to have a selective earth fault protection, the resistance circuit will be equipped with earth – leakage relays.
- The 2 CT’s for the limiting earth fault current resistance Rh1/Rh2 shall be part of the scope of supply of the transformer supplier and shall be placed with the resistor.
- The CT’s for Rhd1/Rhd2 will be installed in the 6.6kV- Cables at E-24 Sub-station shall be in the scope of contractor. (As per 6.6 kV Switchgear Manufacturers Specifications) the earth fault relays will be supplied and installed in the corresponding control panels at E-14 which includes in this tender scope. The required co-ordination is in contractor’s scope.
- With regard to earthing of the 33/6.6kV-Station the following shall be noted:
  - An underground earthing mesh works to be installed, stretching over the whole area of the 33kV-switchyard as required by Qatari regulations / IEC standards.
  - In rocky areas (as at the plant site) the depth of earthing conductors shall be more than 1.0m.
  - Earthing conductors should be lead sheathed stranded copper conductor connected to bare copper or copper-clad steel earthing rods (3.0m length at least) should touch the waterbed.
  - The earthing system for the 33/6.6kV-Transformer station has to be separated from any other earthing systems installed within the Cement Plant.
- All possibly installed metal fences need to be earthed.
The application of earthing rods for this 33/6.6kV-station shall be checked under consideration of IEC & IEEE Standards and shall be designed according to the earth resistance measurements. Each earth pit shall be less than 0.5 Ohms in isolation with grid / other pits. No of earth pits and earthing system design should be according to IEC to maintain required touch and step potential etc. The earthing system should be treated as isolation system from other earthing grids / system for all calculations.

The earthing system for lightning arrestors should be separated from any other earthing system installed within the Cement Plant.

5.8 INSTALLATION WORK

The scope of supply includes full responsibility of the design, delivery, shipping to site of all required equipment as well as the complete installation of all supplied equipment, testing, coordination work with KAHRAMAA and putting into operation of the complete installation.

All relevant erection and installation work shall be included. This includes in particular all required Civil design and construction of the required building and transformer bays, pits and cable trenches for 33kV-6.6kV Power-and control cabling.

The 33/6.6kV-transformer station E-14 shall be adjacent to the 6.6kV-Distribution Station E-24 (indoor installed), and shall be protected by a min. 2m high wire mesh fence and 1m barbed wire on top.

The Transformers shall be sun-protected by a sun shed; each installed in an individual block work bay, isolated and locked.

The installation shall follow applied rules and standards in Qatar.

Cables laid in the ground shall follow KAHRAMAA regulations and standards. Refer: Part-6 – Cable Installation Method – 33 kV Cable - For Further Details
6. CABLE INSTALLATION METHOD FOR 33KV – CABLE

TABLE OF CONTENTS

6.1 CABLES

6.2 JOINTS AND TERMINATIONS

6.3 INSTALLATION

6.3.1 Road Crossing Ducts
6.3.2 Cable Laying
6.3.3 Backfilling
6.3.4 Jointing And Termination
6.3.5 Cable Records
6.3.6 Earthing

6.4 CABLE IDENTIFICATION

6.4.1 Cable Route And Joint Markers
6.4.2 Cable Markers
6.4.3 Core Markers

6.5 CABLE PROTECTION

6.6 BONDING

6.6.1 Pilot Cables
6.6.2 Power Cables
6.7 TESTING

6.7.1 Power Cables

6.7.2 Pilot / Control Cables

6.8 INSPECTION
6.1 CABLES

The 33kV-Cable shall be of the cross-linked polyethylene insulated XLPE-type.

6.2 JOINTS AND TERMINATIONS

Joints and terminations for the 33kV-cables & 6.6 kV cables shall be approved dry type without the need for compound filling.

6.3 INSTALLATION

Underground cable installation, jointing and termination shall be carried out by skilled, experienced workmen under competent supervision.

Trenches shall be kept as straight as possible and shall be excavated to approved formations and dimensions.

The sizes of the trenches shall basically be as per the attached typical drawings.

6.3.1 Road Crossing Ducts

Cables below roads shall be installed within protection ducts. Such ducts shall be completely embedded in concrete with a minimum 100mm thickness of concrete surrounding the ducts on all sides. This is only an indicative figure. Exact designing shall be done after considering the loading factor of the roads when the crossing is taking place. At least 3 spare ducts shall be provided. Ducts shall be sealed at each end, with split teak wood plugs and bitumen or by other approved means to prevent the ingress of water and vermin.

Alternatively, cable ducts may be in the form of steel pipes driven under asphalted road by pipe ramming method.

All necessary diversions and warning signs and / or alternatively diversion routes shall be provided in case existing roads or graded defined tracks are temporarily blocked for execution of the work.
6.3.2 **Cable Laying**

Before the cables are laid, the bottom of the trench shall be lined with sifted soil or with approved soft sand well tamped down to a minimum depth of 100mm to form a bed. After the cables are laid, the first cover of backfill shall consist of sifted soil or approved soft sand well watered and tamped down to depth.

Cables shall be laid direct from drums.

Physical separation between feeders shall be foreseen, as single core cables will be installed (Separate trenches for each feeder).

Sufficient number of rollers shall be provided to avoid twisting of cable on its longitudinal axis during the pulling operation.

Rollers shall be placed as close as possible to avoid abrasion to the cable serving.

Cable laying operations shall be carried out with all care and attention, to ensure that no damage to the sheath, armor or its serving is caused during the process.

The ends of cross-linked polyethylene cables shall be capped to prevent ingress of moisture into the filler or other hygroscopic elements of the cable. The caps shall remain intact during transport and laying operations.

6.3.3 **Backfilling**

After the cables have been laid, the trenches shall be backfilled in 150mm thick layers, which shall be well watered and rammed and consolidated.

Unsuitable excavated material shall be removed from site and selected soil supplied and used for backfilling.

After backfilling to depth as shown in drawing No. F.10168/Bs/111 the complete cable run shall be protected by a cover consisting of concrete tiles in continuous length and width.

After backfilling to further depth as shown in the drawing, caution tape 150m wide in red color printed with black letters in indelible material shall be placed in continuous length.

The surface of refilled trenches shall be temporarily reinstated in a thoroughly safe condition until complete consolidation of the soil is achieved.
6.3.4 Jointing and Termination

Cable sealing and jointing shall be carried out strictly in accordance with the manufacturer’s instructions and shall be of first class workmanship.

Cable sealing used as earth continuity conductors shall be properly bonded to glands and bonding clamps to provide a low resistance path under fault conditions.

XLPE insulated cores shall be protected from UV radiation by approved means.

6.3.5 Cable records

Records of cables shall be carefully taken on site during the execution of the works. The records shall show the routes, the exact location of each cable, the position of joints and terminations, the date of jointing, weather conditions prevailing, the date of testing, the name of jointer, the lengths between joints, the serial number of cable drums, the direction of lay of cable, that is A to Z ends, and where more than one cable is laid, sectional inserts of cable trench. Any other services that cross the route of the cable shall be recorded.

6.3.6 Earthing

All cable armor to have links to earth to enable testing of sheath. Earth resistance shall not be greater than max. limit as per IEC / KAHRAMAA standards (should not be more than 0.05 ohms).

6.4 CABLE IDENTIFICATION

6.4.1 Cable Route and Joint Markers

Cable route and joint markers shall be of reinforced concrete as shown on drawing No. 10168/ Bs/110 & F.10168/ Bs/113. Route markers shall be placed at intervals of 50 meters and at points of route alignment changes.

6.4.2 Cable Markers

All power and pilot cables shall be provided with identification markers at their terminations and at points along the route at intervals of not more than 25 meters apart. Markers shall be made of permanent material of an approved type.
Core Markers

Cores of solid dielectric and plastic insulated low voltage multi core pilot/control cables shall be identified with lettered and numbered marking ferrules which shall be made of permanent material and shall be of an approved type.

CABLE PROTECTION

Where cables are installed and exposed to direct solar radiation, sunshields of approved material and design shall be provided.

BONDING

Pilot cables

The armor of pilot cables with extruded outer sheaths shall be bonded together and connected to earth at all terminating and jointing accessories. Solid bonding connection shall also be made between adjacent multi core cables at terminations and joints.

Power cables

All schemes employing cables having an extruded outer covering shall be installed as an insulated system.

Cable screens shall be solidly bonded to earth at each end of the route.

Fiber Optic Cables and OTB’s

All fiber optic cables & OTB’s shall be as per KAHRAMAA specifications including supply, laying and termination and testing.

TESTING

When the installation of cables and associated jointing accessories has been completed, the cable shall be tested according to the requirements of IEC and / or KAHRAMAA requirements. All the pre-commissioning tests as per KAHRAMAA at site shall be included in the scope. It is assumed that following tests have to be carried out:
6.7.1 **Power Cables**

- Conductor Resistance Test
- High Voltage Test.

6.7.2 **Pilot / Control Cables**

- Insulation Resistance Test
- Continuity Test.

6.7.3 **Optical Cables/Serial Communication Cables**

- End to end test

6.8 **INSPECTION**

The following inspections by appropriate authority shall be carried out at the following stages of Work:

a) Cable trench before laying of cables.
b) Cables laid in trench before back filling.
c) After protection tiles are laid.
d) After warning tape is placed.

Further work at each stage shall be proceeded only after inspection and approval.
7. TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

7.1 GENERAL

7.2 STANDARDS

7.3 TECHNICAL DATA

7.4 TECHNICAL SPECIFICATIONS

7.4.1 Incoming Feeder Panel
7.4.2 Outgoing Feeder Panel
7.4.3 Coupling Panel
7.4.4 HV Circuit Breaker
7.4.5 HV-Disconnectors (Isolating Switch)
7.4.6 Busbar
7.4.7 Power Transformer
7.4.8 Power Cables
7.4.9 Metering and Control Panel
7.4.10 Auxiliary Panels
7.1 GENERAL

The switchgear should be of SF6 – insulated, type-tested, metal clad type with vacuum circuit-breakers.

- The factory-assembled type-tested panels should be of uniform dimensions, regardless of the rated current. All control and monitoring elements should be accessible.

- For reasons of operating reliability, the switchgear should feature single phase encapsulation. All high-voltage components must be sealed hermetically and safe to touch. SF6 may be used only as an insulating medium, not for quenching. The prescribed insulation levels should be upheld without additional insulating material inside the gas compartments. Reliable operation of the switchgear must be assured even in the event of pressure drop to normal level.

- Short disconnection times for expansion work at each end of the system must be assured. Equipment allowing expansion without disconnection should be offered, provided that it does not take up any space in the panel width and depth.

- The degree of protection of the high-voltage section should be IP65. The minimum degree of protection for Control Cabinets / Low Voltage Section is IP4X.

- The arrangement of the circuit-breaker in the panel must be such that in the event of any necessary inspections both the operating mechanism and the arcing chambers can be removed and reinstalled from the front or back in a verifiably short time. The busbar must remain in uninterrupted operation and there must be no reduction in either the insulation level (additional measures such as protective barriers are not permitted) or personnel safety. Confirmation must be provided with the quotation.
Each sealed – off gas compartment must have its own pressure relief facility, which in the event of an arcing fault, prevents uncontrolled rupturing of the compartment. The manufacturers must guarantee an adequate pressure reserve between the operating value of the pressure relief and the rupturing pressure of the vessels. The pressure relief facilities must limit the effects of a fault arc to one compartment. Gas escaping under pressure must be diverted in a direction that is not dangerous for operating personnel; the same applies to fixed parts (rupture diaphragms etc.)

Pressure monitoring to be with contact-making manometer gauges, which function independently for each busbar section, circuit-breaker gas compartment, three position switch gas compartment or busbar voltage transformer set respectively.

The gas compartments must be well sealed both mutually and to their surroundings. The gas loss must not 0.5% per year and compartment. The filling pressure must be selected so that after twenty years of operation the full test voltages can still be withstood without any topping up.

The use of plastics must be minimized, in order to likewise minimize the risk of fire in the event of a fault.

Sheet steel covers shall be provided at rear and both left / right sides of the switchgear.

The bottom side of the panel cable entry points etc. shall be dust sealed.

STANDARDS

The switchgear must comply of latest editions with the VDE standards and IEC publications:

TECHNICAL DATA

* Rated Voltage 36 kV.
* Operating Voltage 33 kV.
* Rated power frequency withstand Voltage 70 kV.
Rated lighting impulse withstand Voltage 170 kV.
Frequency 50 Hz.
Rated short-circuit breaking current 40 KA
Rated short-circuit making current 100 KA.
Rated short time current 3 s 40 KA mini.
Rated current of busbar min. 1250 A.
Rated current of incoming feeders min. 1250 A.
Rated current of outgoing feeders min. 1250 A.
External Paint finish RAL 7032
Ambient Temperature 50°C
Degree of protection of high-voltage section IP 65
Degree of protection of low-voltage section IP 54
Control voltage of motor operating mechanisms 110 VDC
Operating voltage for control and protection 110 VDC

TECHNICAL SPECIFICATION SHEET

7.4.1 INCOMING FEEDER PANEL

Switch panel should be equipped with:

* SF6 gas insulated busbar
* Vacuum circuit breaker (sep. sheet)
* Disconnectors (isolating switch) (Sep. Sheet)
* Current transformers
* Voltage transformers
* Panel connections for cables with cable plug connector
* Multifunction relay for protection system according to IEC standards (should be installed in separate metering & control Panel) and should have the functions:
  - Over current / overload protection
  - Short circuit protection
- Earth fault protection
- Differential protection for power transmission cable
- Under / Over voltage protection

* Gas monitoring for circuit breaker gas compartment with pressure gauge with two signaling contacts for “Pressure rising” & “pressure falling” signals
* Miniature Circuit breakers with auxiliary contacts.
* Control, monitoring and protection relay should be placed in separate control, monitoring and protection panel in separate air-conditioned room in 33 kV Substation building.
* Ammeters
* Voltmeters

Test plugs

7.4.2 OUTGOING FEEDER PANEL

Switch panel should be equipped with:

* SF6 gas insulated busbar
* Vacuum circuit breaker (sep. sheet)
* Disconnectors ( isolating switch) (Sep. Sheet)
* Current transformers
* Panel connections for cables with cable plug connector
* Gas monitoring for circuit breaker gas compartment with pressure gauge with two signaling contacts for “Pressure rising” & “pressure falling” signals
* Miniature Circuit breakers with auxiliary contacts.
* Control, monitoring and protection relay should be placed in separate control, monitoring and protection panel in separate air-conditioned room in 33 kV Substation building.
* Multifunction relay for protection system according to IEC standards (should be installed in separate metering & control Panel) and should have the functions:
  - Over current / overload protection
  - Short circuit protection
  - Earth fault protection
  - Differential protection for transformers
  - Neutral voltage displacement protection for transformers
* Ammeters and test plugs
7.4.3 COUPLING PANEL:

Switch panel should be equipped with:

- SF6 gas insulated busbar
- Vacuum circuit breaker (sep. sheet)
- Disconnectors (isolating switch) (Sep. Sheet)
- Current transformers
- Multifunction relay for protection system according to IEC standards (should be installed in separate metering & control Panel)
- Gas monitoring for circuit breaker gas compartment with pressure gauge with two signaling contacts for “Pressure rising” & “pressure falling” signals
- Miniature Circuit breakers with auxiliary contacts.
- Control, monitoring and protection relay should be placed in separate control, metering and protection panel in separate air-conditioned room in 33 kV Substation building.
- Ammeters
- Voltmeters

7.4.4 HV CIRCUIT BREAKER

Vacuum circuit-breakers with maintenance –free contact system should be used

- The vacuum circuit breakers should be equipped with:
  - 1 Closing Coil
  - 1 Shunt release
  - Operating cycle counter
  - Auxiliary switch with at least 4NO + 3 NC available
  - Auxiliary switch for “spring charged” signal
  - Breaker tripping signal
- Spring stored energy mechanism:
  - Electrically operated
  - Mechanically operated
- Circuit breaker control:
  - Electrically (remote & local)
The circuit-breaker has to control at least 20,000 breaking operations at rated current or 50 breaking operations at rated short-circuit breaking current without maintenance. The mechanical life of the vacuum interrupter has to comprise at least 30,000 operating cycles.

7.4.4 HV CIRCUIT BREAKER

- The operating mechanism must be maintenance–free without time limit up to 10,000 operating cycles. Its service life has to comprise at least 30,000 operating cycles.

7.4.5 HV-DISCONNECTORS (ISOLATING SWITCH)

- Operation:
  - Electrically
  - Mechanically
- Operation Interlocks
  - Electrical
  - Mechanical
- Switching status indicators
  - Aux. switches for local and remote indications
  - Mechanical indicators for local indication
- Total Nos. of HV-Disconnectors: as per single line diagram

7.4.6 BUSBAR

- Copper conductor
- SF6 gas insulated
- Thermal expansion and contraction movement should be absorbed.
- Earthing switch for busbar section:
  - Electrically operated
  - Mechanically operated
Operation interlocks:
- Electrical
- Mechanical

It should be possible to earth all busbar sections in a make-proof way.

**IV.7.4.7 POWER TRANSFORMER**

- Three-phase oil immersed transformer ONAN
- Rated power, MVA : 30
- Voltage ratio, kV : 33 + 12 x 1.25% - 8 x 1.25%/6.930
- Voltage ratio, kV (Load) : 33 + 12 x 1.25% - 8 x 1.25%/6.600
- Frequency, CPS : 50
- Connection : Dyn 11
- Standards : IEC
- Insulation level, windings : min. LI 170 AC 70 / LI 60 AC 20
- Insulation level, Bushings : min. LI 200 AC 70 / LI 75 AC 28
- Temperature rise Oil / windings : 50 / 55 °C
- Impedance Voltage, % : Preferable around 10%
- Conservator
- Vacuum proof tank with detachable radiators:
  - Porcelain bushings
  - Lifting hooks
  - Jacking lugs
  - Pulling eyes
  - Drain valve with sampling plug
  - Earthing terminals (02 Nos.)
  - Rating and diagram plate
  - Air insulated cable termination box for LV / HV sides
  - LV un-drilled brass gland plates, including cable glands
7.4.7 POWER TRANSFORMER

- Conservator shut off valve
- Oil level indicator, contacts: min. 1NO, max. 1NO
- Pressure relief device, contact: tripping 1 NO
- Winding temperature indicator, contacts: Alarm 2NO, Tripping 2NO
- Terminal box for auxiliary wiring
- Filter valve with blank flange
- Silica gel breather for main conservator
- Silica gel for tap changer conservator
- Buchholz Relay, contacts: alarm 1NO, tripping 1NO
- Oil thermometer, contacts: alarm 2NO, tripping 2NO
- Plain rollers, 90 degree turn able
- Neutral grounding resister (NGR)
- Current Transformer to be placed with NGR
- Protection system for Transformers
- Bushings should comply with IEC standards.
- Solid porcelain type bushings should be located on the top of the cover (tank) or side of Transformer Tank.
- There should be provision to change the insulators (bushings) without opening the transformers.
- Air insulated enclosures (Cable boxes) of IP65 rating should be provided for terminals and cable connection on both primary secondary sides of the transformers. The cables should be entered from bottom of the cables boxes.
- Surface Treatment
  - Painted tank RAL 7032 light grey
  - 180 μm according to standard
  - Hot dip galvanized radiators

Surface Treatment

- Painted tank RAL 7032 light grey
- 180 μm according to standard
- Hot dip galvanized radiators

Required for new 5000 TPD clinker cement production line - 5
7.4.7 **POWER TRANSFORMER**

- On load tap changer: should be equipped with:
  - Automatic controller
  - Tap changer conservator
  - Oil level indicator
  - Shut off valve and protective relay: tripping contact 1 NO
  - Contacts for parallel operation

- On load tap changer’s motor drive unit supply voltage
  - Motor: 3 PH, 415 VAC, 50 Hz.
  - Control: 1 PH, 220 VAC, 50 Hz
  - Heater: 1 PH, 220 VAC, 50 Hz

7.4.8 (A) **POWER CABLES 33 kV**

Two parallel circuits of cables from KAHRAMAA – 33kV primary substation to 33 kV incoming feeders at **Sub-station E-14**

Two parallel circuits of cables from outgoing feeders at **Sub-station E-14** to power transformers

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum system (rated Voltage) voltage</td>
<td>36 kV</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>33 kV</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Impulse level</td>
<td>170kV</td>
</tr>
<tr>
<td>Transmission capacity per line</td>
<td>30 MVA</td>
</tr>
<tr>
<td>Rated current per phase</td>
<td>As per IEC</td>
</tr>
</tbody>
</table>

**Single Core**

- Total length of single core cable: As per site Requirement (Co-ordinates for the sub-station have been given for the ready reference).

**Conductor**
- Type: Round, Stranded
- Material: Copper
- Cross Section: Suitable to transmit the 30 MVA continuous (site condition). Each circuit the max. No. of cables should not be more than - 2 Nos. per phase.

**Conductor Screen Insulation**
- Type: Fully bonded
- Material: Semicon., XLPE
7.4.8 (A) **POWER CABLES 33 kV(CU/XLPE/CW/LEAD/HDPE**

Insulation Screen - Metallic Sheath/Lead-Alloy ½C
Type : Copper wire & tape
Material : Copper
Thickness : 1.5 mm/MINIMUM

Insulation Screen - Outer Cover
Material : HDPE
Thickness : 2.5 mm
Conductive layer : Yes

7.4.8 (B) **POWER CABLES 6.6 kV**

All the cables connecting between Transformer to 6.6 kV panel (Incomer) at Substation E-14
Un-armored Copper Conductor XLPE insulated according to IEC Standard.
Maximum system (rated Voltage) voltage : 6.6/11 kV
Operating voltage : 12 kV
Frequency : 50 Hz.
Impulse level : ----
Transmission capacity per line : 30 MVA
Rated current per phase : As per IEC
Single Core
Total length of single core cable : As per site Requirement

Conductor
Type : Round, compacted
Material : Copper
Cross Section : Suitable to transmit the 30 MVA continuous (site condition).
METERING AND CONTROL PANEL

- Free standing Metering panel for billing purpose according to KAHRAMAA – requirements for incoming feeders 1, & 2 with the option of individual and summation metering. This panel should be installed in separate air-conditioned lockable room at E-14 or Umm-bab 132/33 kV Sub-station-2 as per KAHRAMAA’s requirement.
- Control, monitoring (HMI) and protection relays panels also should be installed in separate air-conditioned lockable room and should be equipped with:
  - Voltmeter with selector switch
  - Ammeters
  - Switchgear control and indication
  - Protection relays
- Automatic tap change control suitable for parallel operation of transformers
- Necessary control, monitoring and protection regarding 6.6 kV main distribution sub-station (E-24). [Like position of earthing switch of 6.6 kV incoming feeder at Sub-station (E-24) and monitoring of voltage (6.6 kV)]
- Transmission of signals for remote monitoring and recording in cement Plant’s CCR (as per M/s. FCB requirements):
  - KW
  - Power factor
  - kWh
  - Voltage
  - Ampere
  - ON/OFF/TRIP status of each panel
  - Fault signals alarms
  - Alarm / signalization
  - Detailed alarm annunciators for each feeder with LCD mimic display and audible alarm.
- Transmission of required signals to KAHRAMAA substation # 2 by latest transmission system (SCADA)- as per KAHRAMAA’s requirements.

AUXILIARY PANELS:

- AC & DC auxiliary panels should be installed in separate air-conditioned lockable room and should equipped with:
  - AC Auxiliaries Distribution Panel
- Should be fed from auxiliary transformer of 6.6kV main distribution substation or from Cement Plant emergency power feeder.
- Outgoings feeders should be available for control, battery charger, lighting and heating etc.

DC Battery Charger Panel, should be equipped with:
- Automatic charging equipment
- Float and rapid charging
- NiCd, maintenance free batteries rack mounted
- O/P Voltage 110 VDC
- Miniature circuit breakers for distributions
- 5 KVA UPS should supply SACDA panel.
- Batteries shall be NiCd maintenance free.
Enclosed Typical Drawing:

1. Layout – General Arrangement  QNCAG0500002
2. Proposed 33kV Building Plan and Elevations  10168/BS/103 - INDICE - 1
3. Typical location arrangement of 33/6.6kV – Transformer Station  UB-2/01
4. Single Line Diagram 6.6kV Main Distribution (FCB) (Tentative)  QNC4e1089001
5. Proposed 132/33/11kV Umm-Bab-2 Ex. Al Udeid-1 - Single Line Diagram (Kahramaa)  UB-2/01
7. Cable laying method  QNCC-CAB-001

NOTE: Short-circuit levels, peak load condition and basic system configuration for ummbab-2 shall be obtained from Kahramaa.

List of Typical Drawings to be provided by the Contractors

1. Typical Cable Laying Method – Details of Cable Markers
2. Typical Cable lying Method – Section of: 33kV & Pilot Cable Trench
3. Typical Cable lying Method – Details of: Ducts for 33kV Cable & Pilots Cable
4. Typical Cable Lying Method – Details of: Joint/Route Markers for Power Cable
5. Qatar Transmission System: Proposed Site for Umm-Bab – 2 132/33/11kV Sub-Station
6. Qatar Transmission System: Location Plant Proposed 2 x 132kV + 2 x Pilot Cables between Umm-Bab & Umm-Bab – 2 Sub-station.

NOTE: For design and engineering etc. requirements, contractor will be responsible to take the exact data from Kahramaa.

*****END OF TENDER*****
NEW 33/6.6KV SUBSTATION
FOR THE NEW 5TH EXTENTION
CEMENT PRODUCTION LINE

METHOD STATEMENT
FOR CIVIL WORKS
(PART OF CABLE LAYING)
PROCEDURES
CONTENTS

1. INTRODUCTION
2. REFERENCE DOCUMENTS
3. SAFETY DOCUMENTS
4. LIMITS OF WORK
5. METHOD OF WORK
6. EMERGENCY PROCEDURES
7. MATERIALS
8. PERSONAL PROTECTIVE EQUIPMENTS (PPE)
9. PLANT AND EQUIPMENT
10. RESOURCES
10. PROTECTION MEASURES
11. WASTE MANAGEMENT
12. HOLD POINTS
1. **INTRODUCTION:**

   The purpose of this method statement is to provide the contractors with safe working practices for civil works related to the laying and jointing of EHV underground power cables.

   33kV Cable from Dukhan Road super and Al Wajbah super substation.

2. **REFERENCE DOCUMENTS:**

   HS & E Plan – Ref. UNICON Safety Procedure

   Quality Assurance – Quality

3. **SAFETY DOCUMENTATION:**

   Permits to work / Limit of access (LOA) (where required)

4. **LIMITS OF WORK:**

   All works will be limited to those contained on any safety document issued and to the contents of this method statement. Any works outside the limits of this Method Statement will require the approval of further documentation by Kahramaa. The working area will be demarked as per approved cable route drawings.

5. **METHOD OF WORKING:**

   Prior to commencement of any civil works related to the installation of cable trench, Jointing bay, Cable duct bank, for extra high voltage under ground power cables the following documentation and data should be obtained and verified, in so far as they are applicable to the particular Civil works installation under consideration and checking with Site engineers:
A) Valid RO2 Permits from the following authorities:

- Ministry of Municipal Affairs & Agriculture (MMAA) – Roads Dept.
- Drainage Department
- Q – Tel.
- KAHRAMAA (Water Distribution Network)

B) Availability of RO3 Permit from Traffic Department.

C) Availability of Municipality Commencement Certificate from the concerned Municipality.

D) Availability of No Objection Certificates wherever required from the following Departments.

1. Qatar Petroleum (QP)
2. Garden Department
3. Environment Department

E) Availability of Approved cable route drawing including details of Trenches, Jointing bay, Ducts, Troughs, Bridges and the like.

F) Details and records of existing underground services and utilities throughout the cable route.

Due consideration shall be given to all information obtained from the above documents during all phases of civil works related to high voltage underground power cables and all necessary precautions, procedures and protection shall be implemented and monitored in line with the detailed requirements that become apparent from the subject documents and data.

### 5.1 CABLE TRENCHES

5.1.1 Prior to commencement of any trenching works, full trench section is to be marked out on the surface with spray paint or chalk, as per the
approved cable route. Cable trenches shall be kept as straight as possible.

Trial holes shall be excavated along the trench length where necessary, and particularly to locate known existing underground services, which shall then be clearly identified and flagged.

5.1.2 Cable trenches shall be excavated by mechanical plant to the greatest extent possible and by hand methods where mechanical excavation is either not permitted or not physically possible.

5.1.3 All cable trenches shall be excavated on the approved cable route, in compliance with the approved trench cross-section and to the correct profile, line and level. Particular care shall be taken to ensure that only the width of trench specified is excavated and opened, that trench sides are vertical, and that the trench bottom is leveled and flat.

5.1.4 The trench depth shall be increased in areas where underground utilities cross perpendicularly and are located near the trench bottom, so that the cables, when laid, shall pass underneath the utility with a reasonable and accepted clearance. The level transition of the cable under the utility shall be carried out gradually.

5.1.5 Where deep cable trenches are excavated and where trenches are excavated in areas of unstable soil conditions, appropriate temporary shoring or bracing of the trench shall be installed to prevent cave-ins and trench collapse, and to ensure the safety of personnel working in the trenches.

5.1.6 Asphalt, rock and other non re-usable debris excavated from the trench, shall be removed from the work site immediately and disposed off at an approved dumping area. Good site housekeeping practices shall be strictly observed and materials/equipment being used for the trenching works shall be arranged so as to minimize any disruption and obstruction to traffic and the traveling public.

5.1.7 In areas where a high water table level causes the trench to become flooded, the trench shall be dewatered and cleared by either pumping or installation of a well point system, depending upon the actual site conditions. Trenches subject to a high water table level must be
shored where necessary to minimize trench wall sloughing. The water removed from the trench shall be disposed of in a proper manner, either by pumping to a storm water system or by water tanker trucks. If water is pumped into the Municipal sewage/storm water system, prior approval must be obtained from the appropriate Authorities.

5.1.8 Where cable trenches cross or are in close proximity to vehicular traveled roads and highways, all necessary barriers, steel plates, warning lights and signs to protect the general public from any hazards associated with the open trenches and pits, shall be installed and maintained. In near schools or residential areas, special attention shall be given to barricading, fencing or wire mesh, in order to protect the public, especially children, from falls or injury.

5.1.9 Following completion of trench excavation works, and before cable installation commences, appropriate precautions shall be taken in order to maintain the condition of the trenches. Maintenance of trenches shall include of cave-ins of the trench walls, de-watering of the trenches, and clearance of debris from the trenches and maintenance of the safety barriers, lights and other protection measures installed.

5.1.10 Immediately prior to commencement of cable installation, a Layer of approved special fine thermal sand bedding is to be installed, laid and leveled on the bottom of the trench, to minimum thickness as per approved drawing. This thermal sand bedding must be well watered and compacted, and must be totally free of any stones, debris and sharp objects which could damage the cables.

5.1.11 After the completion of the cable section installation and dressing work, and prior to commencement of thermal sand filling/surround installation, the full cable section shall be inspected to ensure it is properly installed, tied and dressed, and there are no stones or sharp objects on or around the cable.

5.1.12 Approved fine thermal sand filling shall then be installed, laid and leveled around the cable and to a minimum thickness as per approved drawing above the cables. The thermal sand fill and surround shall be well watered and compacted and must be totally free any stones, debris and sharp objects which could damage the installed cable. No
sharp metal tools such as fork spades etc. Shall be used in the placing in this material.

5.1.13 The installed buried cables shall be protected by approved reinforced concrete cable slabs above each circuit. The cable slabs shall be laid end to end on top or thermal sand at a height above trench bottom as per the approved drawing and overlay the outermost cable in the circuit by a minimum of 100mm.

5.1.14 Following completion of installation of thermal sand fill and surround, the concrete cable slab and where applicable the bentonite filling to duct banks, and prior to commencement of trench reinstatement the test shall be carried out (by others) on cable length, to verify sheath integrity.

5.1.15 No trench reinstatement works shall commence until the cable sheath test has been successfully completed, and all required as-installed data has been recorded for the compilation of route records.

5.1.16 All trenches and other excavations shall be backfilled using approved, screened and selected excavated material as a general practice, or with selected imported material where excavated material is not suitable.

5.1.17 Back filling shall be installed in 150mm layers. Each layers shall be leveled, watered and well compacted using mechanical compactors (generally a vibrating plate compactor). The level of this backfill shall be brought up in the 150mm layers to within 100mm of the original surface level.

5.1.18 An approved PVC warming tap shall be laid continuously above each circuit at a distance of 300mm above the top surface of concrete cable slab. Care shall be taken to ensure complete continuity of such warning tapes and to avoid displacement of the tapes during backfilling.

5.1.19 The top surface of the trenches and other excavations shall be reinstalled to match the ground surface existing prior to the excavation being recommended.
5.1.20 Any other facility or item which has been damaged or disturbed during the course of the works (e.g. Fences, Kerbs etc) shall be reinstated/restored to the same condition as at commencement.

5.1.21 Approved, painted pre-cast concrete marker domes shall be installed at various points along the cable route. Such marker domes are to be installed at all joint bay position, at all road crossing positions, at all points where the cable route changes direction and at distances of approximately every 25 meter on straight sections of the cable route depending on topography. Additional marker domes shall be installed wherever necessary in order to clearly identify route of the cable installed.
5.2 : Cable Duct Banks

5.2.1 Underground concrete encased cable duct banks shall be installed at all locations required under the Contract and as identified on the approved cable route drawings. Duct banks are generally installed at roads crossings, factory and business entrances and other areas where vehicular traffic is heavy.

5.2.2 Cable duct banks shall be constructed in compliance with the approved details and specification and shall be installed in as straight a line and level as possible. Unless otherwise specified duct pipes shall be UPVC to BS 3505/3506 class B, with spigot and socket joints and concrete surround shall be SRC ready mix to BS 1926, cube strength at 28 days 14 N/mm², minimum cement content 150 Kg/m³ and generally complying with BS CoP 110 P† 1 (1973).

5.2.3 Bell ends shall be provided at the entrance of each duct; this can be the socket as manufactured at one end of the standard duct pipe, or can be fabricated to suit at site.

5.2.4 Upon completion of the construction of a duct bank all ducts shall be tested to ensure that they are correctly aligned and free of obstructions, by drawings a test mandrel through the duct. The diameter of the test mandrel shall be approximately 6mm less than the nominal internal diameter of the duct.

Following Completion of the testing the ducts shall be cleaned by drawing a wire or nylon brush cleaner through the duct. The diameter of the brush cleaner shall be of a slightly larger diameter that the duct.

This testing and cleaning of the concrete encased duct banks should be undertaken on the day after the concrete has been poured, in order to eliminate any concrete which may have seeped into the ducts during pouring.

5.2.5 On successful completion of the proving test and cleaning of the ducts, a nylon pull rope shall be installed in each duct line and then the duct mouths at each end shall be temporarily, but effectively, sealed in order to prevent ingress of moisture, sand, debris, insects and rodents.
5.3 Route marker

Route marker shall be required at both ends of the joints bays, location where route changes direction, at both ends of ducts road crossing and at a maximum interval of 15 meters on straight runs.

5.4 Jointing Bays, Earthing Cabinet pit & PD Cabinet Pit

Prior to commencement of any Jointing Bays, Earthing Cabinet pit & PD Cabinet Pit works, the location of each Joint bay, Earthing Cabinet pit & PD Cabinet Pit works shall be marked out on the surface with spray paint or chalk, as per the approved location.

Joint Bays, Earthing Cabinet pit & PD Cabinet Pit shall be excavated on the approved location, in compliance with the approved Joint Bay, Earthing Cabinet pit & PD Cabinet Pit drawing and to the correct profile, line and level’. Particular care shall be taken to ensure that only the width of Joint bay, Earthing Cabinet pit & PD Cabinet Pit specified is excavated and opened and the allowance is given for the working areas out side the Joint bay, Earthing Cabinet pit & PD Cabinet Pit walls.

Blinding shall be done as per the approved drawings after proper compaction of the area to receive the bed of the joint bay, Earthing Cabinet pit & PD Cabinet Pit.

The concrete works shall be carried out as the following procedures.

The supply the concrete shall be arranged with in the vicinity of the Site area.

What actually shall have to be verified is the cycle time required for concrete mixing at the plant, loading, transportation to Site, maneuvers and setting in addition to casting. The latter shall have to be always less than the period required in the relevant Standards.

Concrete trial mixes shall be submitted for KAHARAMAA approval selection of which shall be followed though out the works. Specimens shall be taken periodically as consented and described in the relevant specification for
testing of concrete consistency in terms of strength and homogeneity.

Prior to any casting of Concrete, specific control shall be applied for forms adequacy when set as well as other relevant issues such as Reinforcements overlap, Reinforcements allowance for minimum cover, vertically (plumb) of shutter, provision of sleeves, supports, and embedded accessories etc. The Section Engineer shall be provided with the necessary check list whereby control is achieved mutually in his presence as well as the presence of the Quality Control Engineer and KAHRAMAA / Representative.

The concrete while poured shall receive densification (removal of voids) by means of vibratory pokers utilization. The application of the latter shall be in successive drops at intervals not exceeding 30 seconds. Care shall be taken in such application in order to eliminate segregation.

Vibrating beams shall be applied on lateral track applied on the slab formation level. While pouring the concrete in front of the vibrating beam, the latter is set into vibrating mode and moved on its track in the direction of the pour.

Pursuant to the above, the program of works induces the completion of the concrete works within the time frame agreed by Kaharamaa. Hence, works are conceived to follow a fast track execution subject to normal hours of operation. Shall any deficiency in execution occur additional manpower hours of operation shall be set forth in order to overcome the relevant delay.

The external wall of the Joint bays, Earthing Cabinet pit & PD Cabinet Pit shall be protected with the specified layers of Bitumen coating, self adhesive membranes and protection board.

Each section shall be handled separately with its own personnel and manpower and the program of works shall be followed accordingly.
5.5 Clearance of Site

Site clearance on completion of the works and removal to an approved dump off site.

6.0 Emergency Requirements

Any incidents, accidents or near misses will be recorded as per our HSL programme and the client will be notified immediately so that they can complete their own procedures.

Details of the nearest Accident & Emergency department will be given to each operative at the site induction and be available at all times within the site staff.

Inform emergency department of the concerned service immediately in case of any damage to the existing services. The emergency services contact nos. are as fellows:

1. Traffic Department : 4890666
2. Water Department : 4325959
3. Electricity Department : 4677601/2
4. QP : 4343227
5. Q-tel : 4400400
6. Drainage : 4339444
7. Municipality : 4336336

7. Materials

Special thermal mix form Ready mix plan
Ready mix concrete
Nylon rope
Safety materials, like net, barriers, flash lamps etc.
Cable tile
Warning tape
Polypropylene strings.
Soft Wood & Marine Plywood
Steel bars
Water

8. **Personnel Protective Equipment (PPE)**

   Hard Hat
   Safety Bouts
   Hi Vis Clothing for night
   Hand Gloves
   Ear Protection (where required)
   Eye Protection (where required)

9. **Resources**

   Project Engineer
   Site Engineer
   QA/QC Engineer
   Safety Officer
   Foremen
   Laborers, as per site requirements

10. **Protection Measures**

    All temporary signs shall be mounted on bases, which are designed to accept sand bags or a similar approved device, which creates a stable base far the signs.

    Traffic safety cones with safety tapes tied across each cone shall be kept throughout each cable trench section and suitable barricades shall be erected wherever required in order to prevent any accident.

    All personnel entering the working area must understand the contents of this Method Statement be signed onto it.
11. **Waste Management**

Demobilize the equipments and machinery from the site and surplus waste materials and any other titter if any shall be taken away from the site.